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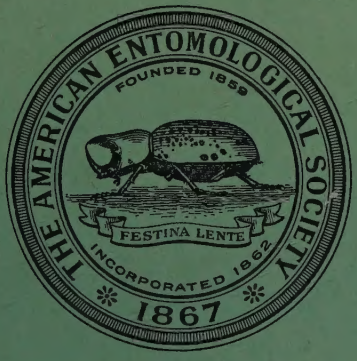

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ON THE GENUS CRYPSICERACRIS (ORTHOPTERA; ACRIDIDAE; LATHICERINAE), WITH THE DESCRIPTION OF A NEW SPECIES

BY JAMES A. G. REHN

Curator of Insects, Academy of Natural Sciences of Philadelphia

(Plate XVII)

In a recent paper Dr. V. M. Dirsh erected the subfamily Lathicerinae [1] to include four genera of rare and little-known grasshoppers from desert areas of Southwest Africa, these being *Crypsicerus* and *Lathicerus* of Saussure, 1888, *Batrachidacris* Uvarov, 1939 (= *Bufotettix* Uvarov, 1929, and *Batrachacris* Uvarov, 1939, both preoccupied), and *Crypsiceracris* N. C. E. Miller, 1932. Of these genera the historic material of *Crypsicerus* was immature, and the genera *Lathicerus* and *Crypsiceracris* were known only from the unique types. Recently the present author published the first figures of and notes on *Crypsicerus* from adult material.[2]

In some material submitted to me for determination by the American Museum of Natural History I was surprised to find two males and one female of the genus *Crypsiceracris*, these being the first male known of the type species (*C. glabra* Miller), from coastal Southwest Africa, and both sexes of an undescribed one, the latter from the interior of the same region. It is a pleasure to place on record this most interesting material.

Crypsiceracris glabra Miller Plate XVII, figs. 1-3.

1932. *Crypsiceracris glabra* Miller, Trans. Entom. Soc. London, LXXX, p. 33, figs. 15a-d. [♀; Rotkop, 22 miles east of Lüderitz, Southwest Africa.]

SOUTHWEST AFRICA: Pomona Island; [3] September, 1925; (Vernay Angola Expedition, H. Lang and R. Boulton) 1 ♂; [Amer. Mus. Nat. Hist.].

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[1] Ann. and Mag. Nat. Hist. (12) 7, pp. 670-672, pls. XIII and XIV (September, 1952).

[2] Notulae Naturae, 271, pp. 1-4, figs. 1-3 (March 25, 1955).

[3] Pomona Island is a short distance off the coast of Southwest Africa, about thirty miles south of Lüderitz Bay [Angra Pequena]. On the mainland opposite the island is a Pomona railway station. Rotkop, the type locality, is on another rail line southwest of Lüderitz Bay, at about 2000 feet elevation.

Dirsh's photograph of the type specimen (♀) of *C. glabra*[4] shows that its abdomen has been abnormally extended, and in consequence its length as given by Miller (36.0 mm.) is excessive. However, from the length originally given for the caudal femora there can be little doubt but that *C. glabra* is somewhat larger than *C. tuberculata* here described. It would also appear, on the basis of Dirsh's photograph of the same specimen, and from what may be judged from the three individuals of the genus now before me, that the genae are shown by Miller (in his figure 15c) as less bullate than is true of the specimen. In this respect the male before me from Pomona Island, and the material of *C. tuberculata*, agree very well with Dirsh's photograph. Similarly Miller's figure shows the eyes in the type as moderately divergent ventrad, which is not supported by Dirsh's photograph of that specimen, nor by the material in hand, all of which have the eyes with their vertical axes subparallel as seen in cephalic aspect.

The present male is the first of that sex of *C. glabra* to be reported, and it is here regarded as the allotype.

Description of Male.—Size medium (length of body, 23.6 mm.); form apterous, broad, depressed; surface of head smooth, dorsum of pronotum shagreenous with numerous low tubercles, dorsal and lateral surfaces of the abdomen rugulose, with a triseriate longitudinal arrangement of subpapilliform tubercles on its dorsum.

Head relatively short, broad, markedly inflated across the genae, so that as viewed in cephalic aspect these latter areas are in outline strongly arcuate dorsad and subparallel ventrad, the greatest breadth across the genae, in the same view, being but little less than the total depth of the head including the labrum (as 53 to 60); dorsal outline of occiput and fastigium, as seen in profile, regularly arcuate, descending cephalad to the narrow interocellar section of the fastigium, greatest breadth between the eyes equal to three-sevenths the greatest breadth across the genae, gutter-like interocellar section of the fastigium strongly compressed, elongate, its lateral margins almost in contact but separated by a very narrow slit, the passage into the interantennal section of the face without any evident angle, no true frontal costa indicated, the above-mentioned section of the face subtrigonal in outline with very low subcarinulate lateral margins, median ocellus evident, no distinct infra-ocular sulci present, antennal grooves on each side of the compressed portion of the fastigium well

[4] Ann. and Mag. Nat. Hist. (12) 7, pl. xiv, figs. 5 and 6.

marked, deep and relatively broad, subarcuate as seen in cephalic aspect, not contrastingly colored as in *Crypsicerus*, median slit of cephalic section of fastigium becoming obsolete dorso-caudad; eyes prominent, their axes vertical as seen in cephalic aspect, in profile with their greatest dimension slightly oblique, as seen in cephalo-lateral aspect with basal outline broadly subreniform, the greatest breadth to depth as 12 to 15. Antennae very short and thick, with nine well-defined articles, the penultimate with an obsolete subdivision, in length the whole equal to about 1.4 times the depth of the eye.

Pronotum short and broad, its greatest breadth across the dorsum equal to 1.8 times the median length of the disk, its dorsal surface distinctly but shallowly concave transversely; cephalic margin of disk distinctly and broadly concave with a number of low but distinct crenulations, caudal margin of disk somewhat more strongly convex with a number of low spaced tubercles, lateral shoulders of pronotal disk diverging caudad, strongly marked and angulate in section, and with their metazonal portion somewhat more produced laterad, all of the shoulders with numerous low tuberculations, transverse sulcus obsolete mesad, well marked laterad and there at the middle of the longitudinal extent; lateral lobes of the pronotum subquadrate in outline, slightly longer than deep, their cephalic and caudal margins slightly diverging dorsad and both with spaced tubercles, on the caudal margin these in groups of two, ventro-cephalic angle of margin obtuse, ventro-caudal angle of margin rounded subrectangulate, surface of lobes subconcave as contrasted with the lateral shoulders of the disk, principal sulcus intersecting the latter and sharply indicated over the dorsal three-fifths of the lobes. Metanotum with no median specialized process, as in *Crypsicerus*, instead having merely a low median carinula, caudal margin subtruncate mesad, becoming arcuate latero-caudad.

Abdomen in general form subconic, evenly narrowing to the rounded apex, the more proximal tergites with a median rounded tubercle on each tergite and a flanking pair of similar structures on the same segments; supra-anal plate lanceolate-trigonal in outline, but slightly longer than the proximal breadth, the section proximad of the transverse impression with a distinct but shallow median impressed area; cerci very short, broad and blunt processes; infra-cercal plates reaching to the apex of the supra-anal plate; subgenital plate broad, poculiform, its distal outline in both dorsal and lateral aspects broadly rounded, its dorsal margin narrowly arcuate-emarginate mesad.

Prosternum strongly transverse, details damaged. Meso-metasternum very broad, distinctly broader than the combined length, the interspaces between the lobes very shallow and broad, with the disto-internal portion of the lobar margin broadly rounded.

Cephalic and median femora of moderate length, their surfaces with a number of low tumidities, particularly pregenicularly on the dorsum and also less so on the caudal aspect of the cephalic femora. Caudal femora

short, but faintly exceeding the apex of the abdomen, robust in both dorsal and lateral aspects, but particularly so in the lateral one, the mid-dorsal carination proximad of the pregenicular constriction with a group of longitudinally and serrately disposed acute tubercles, external paginal surface strongly convex in section and with a regular pattern of generally subrhombiform well-etched impressions, dorso-external carina of external paginal surface in greater part obsolete, ventro-external carina of same well marked, external ventral carina lamellate elevated and in lateral view with an arcuate outline; caudal tibiae robust, very slightly shorter than the femora, supplied with five external (no apical) and seven internal (one apical) spines, those of the external margin very appreciably longer than those of the internal; caudal tarsi in length but slightly less than half that of the tibiae, the proximal article slightly longer than the third, tarsal claws symmetrical, pulvillus well developed.

Measurements.—Length of body, 23.6 mm.; length of antenna, 3.9; median length of pronotum, 6.5; greatest breadth of pronotal disk, 11.7; length of caudal femur, 13.3.

Coloration.—General tone cream to creamy-buff, washed or touched areally with deeper buff, this evident on the pronotal dorsum, mesad on the proximal abdominal tergite, on areas of the cephalic and median limbs and the more elevated borders of the rhomboid pattern of the external pagina of the caudal femora, the rhomboid impressions themselves being almost dead white. Proximal abdominal tergite with lateral areas and also parts of the adjacent metanotum pale wood brown; antennae very pale buff, slightly darker on dorsal surface; eyes buffy brown; caudal tibiae buff, the spines fuscous-tipped.

Crypsiceracris tuberculata new species Plate XVII, figs. 4-9.

Compared with *C. glabra* Miller this interior species differs in both sexes in its somewhat smaller size, in having its integument much more rugulose, in the triserrately disposed tubercles of the more proximal abdominal tergites being much more decided, conical and largely acute, while the pronotal disk has the lateral margins more distinctly serrulate. In the male sex also the eyes are slightly more prominent as seen in both dorsal and cephalic aspects,[5] the supra-anal plate is somewhat broader trigonal and less lanceolate, and the mediodorsal carina of the caudal femora is more heavily spinulose. The much more decided and conical tubercles on the proximal abdominal tergites, and the generally

[5] This may also be true of the female sex, but as I have no material of that sex of *glabra*, and know only Miller's figure, which may be somewhat generalized, and Dirsh's photograph, I hesitate to include the female sex in this comparison.

more rugulose texture of the integument, will at once distinguish this species from *C. glabra.*

Type.— ♀ ; Keetmannshoop,[6] Southwest Africa. September, 1925. (Vernay Angola Expedition; H. Lang and R. Boulton.) [American Museum of Natural History.]

Size medium (body length, 30.3 mm.); general form essentially as in *C. glabra* Miller; surface as a whole more rugose and tuberculate.

Head with its general proportions and form as described above for *C. glabra,* profile of occiput and fastigium as in same; surface of interocular section of fastigium lightly rugulose (smooth in *glabra*), narrow cephalic section of fastigium, its margin and median fissure as described above for *C. glabra,* antennal grooves as in same; eyes much as described for the male sex of *glabra* but slightly broader in basal outline (as 13 to 16). Antennae as in male of *C. glabra* but with ten well-defined articles.

Pronotum in general form as in the male of *glabra* but slightly longer and less strongly transverse, its greatest breadth equal to 1.7 times its median length, its dorsal margin more deeply concave than in the male of *glabra* and with very weak and obscure crenulations, caudal margin of disk much like that of the male of *glabra* but with its ten or so regularly spaced tubercles larger, more pronounced and sharper than in *glabra*; lateral shoulders of disk somewhat more strongly diverging caudad than in *C. glabra,* with their asperities more numerous, sharper and more pronounced, the portion of the shoulders caudad of the transverse sulcus more prominent, transverse sulcus subobsolete mesad, distinct laterad, surface of disk with many asperities of varying size, all coarser than shagreen, the most pronounced ones being grouped as follows: a reversed V-shaped group mesad on the prozona, a transverse linear, ridge-like assemblage immediately cephalad of the usual position of the transverse sulcus and extending across more than half the discal breadth at that point, a less regular intra-marginal grouping following the whole of the caudal margin of the disk; lateral lobes much as in *C. glabra* but surface with more numerous and heavier tubercles caudad. Metanotum as in *C. glabra.*

Abdomen conic in outline, narrowing regularly distad, the more proximal tergites with their surface shagreenous, the first to fourth also with well-marked elevated tubercles triseriately arranged, the median one on the proximal (first) tergite thicker and broader than the others, the lateral ones on the second and third tergites more acuminate than any of the others, the lateral ones on the proximal tergite continued latero-cephalad as diminishing ridges, all on the fourth tergite less marked than those on preceding tergites, the spaces between these more conspicuous tubercles largely filled with tubercles of a lower order, more distal tergites with but weak intimations of the lateral series seen on the proximal ones;

[6] Keetmannshoop is about 200 miles nearly due east of Lüderitz Bay, at an elevation of 3373 feet.

ultimate tergite mesad completely covered by the proximal section of the supra-anal plate, which latter is subovate-lanceolate with its apex narrowly rounded, its surface with a shallow medio-proximal impression; cerci very short, broad and blunt processes; infra-cercal plates surpassing the apex of the supra-anal plate, their distal margins oblique subconcave; ovipositor valves very short and stout, the dorsal pair with their dorsal surface deplanate proximad and this area sharply cut off from the very brief concave-excavate distal section, dorso-lateral margins cingulate but not dentate, ventral ovipositor valves exceedingly short, each broader than long, ventral surface with a marked transverse cingulate shoulder separating the transversely concave distal section from the deplanate proximal one, combined distal margins as seen from venter sinuato-arcuate, with a concavity of the emargination at the middle of the margin of each valve; subgenital plate moderately transverse, subquadrate, its distal margin biconcave with a low median obtuse production.

Prosternum strongly transverse, with a transverse, subarcuate carinate ridge, which marginally is crenulato-serrulate. Mesometasternum as described for the male of *C. glabra*.

Cephalic and median limbs as described above for *C. glabra*. Caudal femora essentially as here described for *C. glabra*, but in length they very faintly exceed the apex of the abdomen, are slightly deeper and have the mid-dorsal carina more elevated and its serrate tubercles more numerous and reaching farther proximal; caudal tibiae and tarsi as described above for *C. glabra*.

Allotype.—♂; same data as type.

Differing from the preceding descriptions of the male of *C. glabra* and of the female (type) of the present species in the following noteworthy respects.

Size slightly less than in the male of *C. glabra* (length of body, 21.2 mm.); form much as in male of *C. glabra*; surface more rugose and rugulose than in *C. glabra* and more as in the female sex of this species, but with the triseriate abdominal tubercles continued more evidently over the distal portion of the abdomen.

Head essentially as in the male of *C. glabra* and with its greatest breadth across the genae, compared with the total depth of the head as in the same; details of fastigium, eyes, and antennae as in the male of *C. glabra* here described, except that the surface of the lower face and genae is more rugulose.

Pronotum somewhat shorter in proportion to its breadth than in the male of *C. glabra*, the greatest breadth across its dorsum being slightly more than 1.9 times its median length (as 67 to 35), its dorsal surface more deeply and strikingly concave transversely than in the same sex of *C. glabra*, cephalic margin slightly more strongly concave than in the male of *glabra*, the caudal margin arcuate but somewhat less strongly so than in the same sex of *glabra*, with similar spaced tubercles, lateral shoulders

of pronotal disk somewhat more prominent than in *glabra*, as seen from the dorsum more irregular and more sharply serrato-denticulate, the indentation of these margins at the transverse sulcus more pronounced, the transverse sulcus evident on the disk but briefly laterad, surface of disk of pronotum distinctly more rugose and rugulose than in the male of *C. glabra*, the areas of definite emphasis being the same ones which are but faintly evident in *C. glabra*, i.e. the lateral quarters, mesad and near the caudal margin; lateral lobes of the pronotum slightly shorter than in the male of *glabra*, more nearly quadrate, the dorsal length at the lateral shoulders being five-sevenths of the greatest depth of the lobes ventrad of the same point (as 25 to 35), caudal margin of the lobes straighter and more vertical than in *glabra*, its five or six tubercles larger and sharper than in *C. glabra*, surface of lobes more concavely impressed and more tuberculate than in *glabra*, transverse sulcus here as in *glabra*. Metanotum much as in *C. glabra* but with its caudal margin as a whole more evenly arcuate but with distinct caudo-lateral obtuse angles.

Abdomen in general form much as that of the male of *C. glabra*, but in sculpture it is much closer to the pattern described for the female sex of the present species, the triseriate disposition of marked tubercles, however, being continued distad to the distal tergite, particularly the lateral ones, which regularly become smaller in size distad, and which are not at all evident laterad on the proximal tergite, while the median series has its representative on the proximal tergite larger in area but more rounded than the following ones of the same series, which are pronounced to the fifth tergite, with those on the third and fourth tergite definitely dentiform, while from the sixth tergite distad they are merely low rounded tubercles; supra-anal plate much as in the male of *glabra* but more acute distad and with the meso-proximal impression bordered laterad by distad-converging rounded shoulders; cerci as in *C. glabra* but even more roundly blunted distad; infra-cercal plates as in *glabra*; subgenital plate as in *glabra*.

Prosternum as described from the female sex of this species, but with its transverse ridge more marked and its serrations are more pronounced, higher and more irregular. Meso-metasternum as described for the male of *glabra*.

Cephalic and median femora essentially as in *C. glabra* but with their surface strumosities somewhat more pronounced and more numerous than in the male of *C. glabra*. Caudal femora as in the made of *glabra* except for the few points mentioned in the description of the female sex of this species, in which the male agrees with the female sex, caudal tibiae as in the male sex of *C. glabra*;[7] caudal tarsi slightly more slender than in *C. glabra*, particularly the distal article.

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[7] The present specimen has six external spines on one margin, but five on the other.

Measurements.—♀ (type); length of body, 30.3 mm.; length of antenna, 3.7; median length of pronotum, 8.1; greatest breadth of pronotal disk, 14.9; length of caudal femur, 13.0. ♂ (allotype); length of body, 21.1 mm.; length of antenna, 3.9; median length of pronotum, 5.7; greatest breadth of pronotal disk, 11.0; length of caudal femur, 12.7.

Coloration.—Buffy, varying areally from cream-buff to buffy-brown, paler and less contrasted in the female than in the male. Much of the surface has the shagreen pattern whitish, appearing as an overlay on the general tone. In the female there is little contrasting coloration except that the dorsum of the pronotum is more brownish than the head or lateral lobes of the pronotum, while the portions of the proximal abdominal tergites which bear the larger tubercles are more buffy-brown. The female has a pair of contrasted subtrigonal fuscous patches on the base of the occiput, with several small ones latero-cephalad of each of the larger ones. This area is not exposed in the allotype.[8] Caudal tibiae in both sexes of the same pale yellow noted in *C. glabra*. In the male of *tuberculata* areas of the head, pronotum, abdomen and caudal femora are more decidedly mottled with brown than in the male of *glabra*. The dorsum of the head and the dorsal surface of the pronotum are washed with brownish, the pronotal dorsum has on each side an irregular subsigmoid longitudinal maculation of umber and similarly marked areas are present mesad on the cephalic two-thirds of the lateral lobes, while the metanotum and much of the abdominal dorsum is washed with red brown, surrounding a pale meso-proximal dorsal area. Caudal femora colored as in the male of *C. glabra*, with the addition of a suboblique bar of reddish brown mesad on the external face reaching from the mid-dorsal carina across the pagina.

The type and allotype are the sole material of the species before me.

Explanation of Plate

(All figures twice natural size)

Crypsiceracris glabra Miller. ♂. Pomona Island, Southwest Africa. Fig. 1.—Lateral view. Fig. 2.—Dorsal view. Fig. 3.—Cephalic view of head.

Crypsiceracris tuberculata new species. ♀ (type). Keetmannshoop, Southwest Africa. Fig. 4.—Lateral view. Fig. 5.—Dorsal view. Fig. 6.—Cephalic view of head.

Crypsiceracris tuberculata new species. ♂ (allotype). Keetmannshoop, Southwest Africa. Fig. 7.—Lateral view. Fig. 8.—Dorsal view. Fig. 9.—Cephalic view of head.

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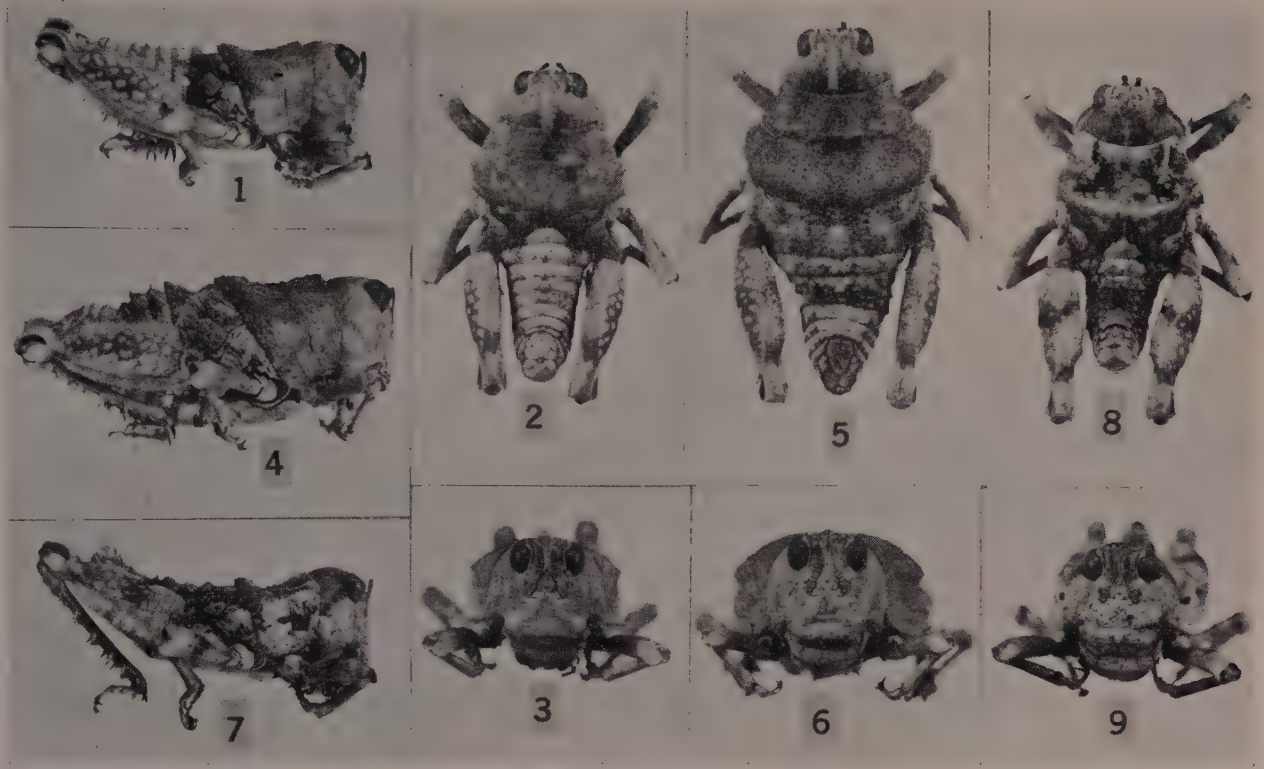
[8] However, the male of *C. glabra* exhibits under the pronotal margin the border of similar but smaller fuscous patches in the same area.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AN ANALYSIS OF TETRIX ARENOSA (ORTHOPTERA; ACRIDOIDEA; TETRIGIDAE)

BY JAMES A. G. REHN AND HAROLD J. GRANT, JR.

Department of Insects, Academy of Natural Sciences of Philadelphia

The present analysis is the fifth of the collateral papers [1] made necessary by work on the projected monograph of the Orthoptera of North America, which is being made possible by grants from the National Science Foundation. A general outline of this work, and acknowledgments of the generous and essential cooperation and assistance we are receiving, have already been presented in the first and second of these contributory studies.

While the other North American members of the genus *Tetrix* show either identity or close relationship to members of the Palearctic fauna, or prefer habitats which are more boreal in character than austral, *Tetrix arenosa* is clearly an austral type, but narrowly intrusive into the Boreal region, and also roughly limited in its distribution to the territory east of the hundredth meridian, or the more humid section of North America.

In *Tetrix arenosa*, quite apart from its segregation into two reasonably well-marked geographic races, we find an exceedingly broad range of morphological variation, largely in the degree of inflation or bullation of the pronotum, conditions which resulted in the past in the bestowal of a number of specific names, which studies since have shown were based merely on individual variations, these not of systematic value. We have already, in this series, touched upon this frequent occurrence in prior systematic work on the tetrigids,[2] which makes the study of these diminutive

[1] The four of these so far published, by the present authors, are: "The North American Tetrigid Genus Nomotettix (Orthoptera; Acridoidea; Tetrigidae)"; Proc. Acad. Nat. Sci. Phila., CVII, pp. 1-34 (1955). "Tetrix subulata (Orthoptera; Acridoidea; Tetrigidae) as occurring in North America"; ibid., pp. 145-165 (1955). "On Tetrix brunneri and a New Species of Tetrix from California (Orthoptera; Acridoidea; Tetrigidae)"; Proc. Acad. Nat. Sci. Phila., CVIII, pp. 97-115 (1956). "The Components of Tetrix ornata (Orthoptera; Acridoidea; Tetrigidae)"; ibid., pp. 117-153 (1956).

[2] Proc. Acad. Nat. Sci. Phila., CVIII, pp. 117-153 (1956).

locusts particularly difficult in the absence of authentically determined series. In the present case, fortunately, almost all the historic material has been before us.

Briefly *Tetrix arenosa* breaks into two subspecies, one of which (typical *a. arenosa*) occurs in peninsular Florida and extreme southern Georgia and narrowly in the coastal sections of Georgia, South Carolina and of southeastern North Carolina, intergrading inland into *T. arenosa angusta*, which latter ranges broadly northward to southern Canada, and west to or slightly over the border of the Great Plains. In coastal Texas there is a rather unusual, but not unique, intergration of the two subspecific elements, which is discussed in more detail in the body of this paper.

It appears to us that *Tetrix arenosa arenosa* may have been much more broadly distributed northward preglacially, that its area of distribution was subject to unfavorable climatic conditions in glacial times, and that a more adaptable stock was then developed, which is represented today by the more widely distributed and exceedingly plastic *T. arenosa angusta*. The exceptional range of structural shadings seen in this subspecies may be interpreted as an evidence of the relative youth of that entity, while *a. arenosa* is as a whole less variable, and distinctly more generalized.

In the course of the present study we have examined a total of 3498 specimens of *Tetrix arenosa*, these from localities covering the entire known range of the species. The present representation and past literature give a total of 765 definite localities for the species.

Key to Subspecies of Tetrix arenosa [3]

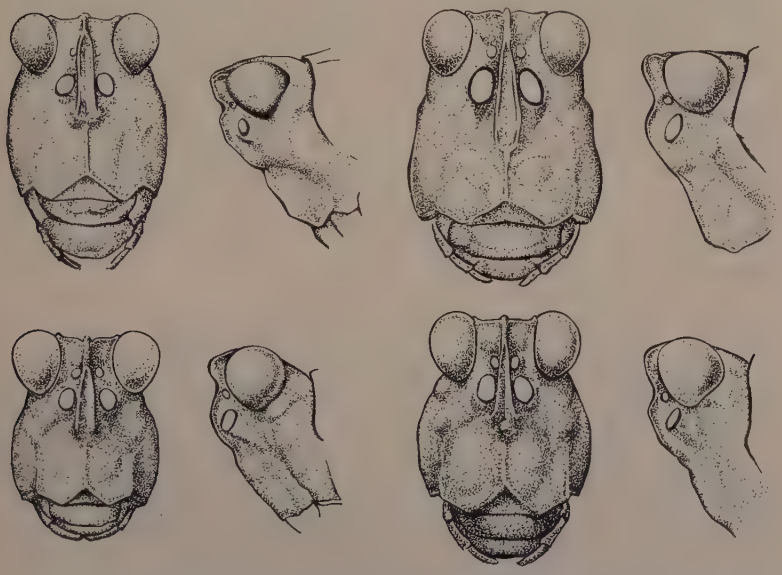
Head as seen in dorsal aspect roughly more subquadrate in outline, eyes in this view slightly larger proportionately, particularly in the female sex, than in *T. a. angusta*, cephalic border of the fastigium in this view at most but very slightly produced cephalad of the eyes; as seen in cephalic aspect the head in both sexes is more appreciably narrowed immediately ventrad of the eyes, the latter in this view more protuberant

[3] As with all keys for distinguishing geographic subspecies this is based on material typical of each of the subspecies, and it must be noted that specimens intermediate between these, or even atypical material of either, will exhibit less clearly marked differential features. Reference to relevant discussion, or consultation of accompanying illustrations, will be helpful in such cases.

laterad, and in the male sex particularly slightly elevated dorsad of the plane of the fastigium; eyes as seen in profile slightly larger proportionately and with their basal outline less subtrigonal.

arenosa arenosa Burmeister

Head as seen in dorsal aspect less subquadrate in outline, eyes in this view slightly smaller proportionately in the female than in *T. a. arenosa*, cephalic border of the fastigium in this view narrowly but definitely produced cephalad of the eyes; as seen in cephalic aspect the head in both sexes is not as appreciably narrowed immediately ventrad of the eyes, the latter in this view less protuberant laterad and in the males hardly, if at all, elevated dorsad of the plane of the fastigium; eyes as seen in profile averaging smaller proportionately and with their basal outline more subtrigonal .....*arenosa angusta* (Hancock)



Morphological features of *Tetrix arenosa*. *Tetrix arenosa angusta*. Fig. 1, top row left, frontal aspect of head, ♂, Chestnut Hill, Pennsylvania; Fig. 2, top row left center, left lateral aspect of head, same specimen as preceding; Fig. 3, top row right center, frontal aspect of head, ♀, Chestnut Hill, Pennsylvania; Fig. 4, top row right, left lateral aspect of head, same specimen as preceding. *Tetrix arenosa arenosa*. Fig. 5, bottom row left, frontal aspect of head, ♂, Mixon's Hammock, Georgia; Fig. 6, bottom row left center, left lateral aspect of head, same specimen as preceding; Fig. 7, bottom row right center, frontal aspect of head, ♀ Mixon's Hammock, Georgia; Fig. 8, bottom row right, left lateral aspect of head, same specimen as preceding. All figures greatly enlarged.

Tetrix arenosa arenosa Burmeister Text-figs. 5-8.

T[*etrix*] *arenosa* Burmeister, Handb. der Entom., II, abth. 2, pt. 1, p. 659 (1838) [♂, ♀; South Carolina].

Tettix blatchleyi Hancock, Tettig. N. Amer., pp. 38, 68, 91 (1902) [♀; Ormond, Florida].

Tetrix arenosa Burmeister. Based on both sexes from South Carolina. Burmeister gives no intimation of the collector of the original material, but this may have been, and probably was, Zimmermann, who sent much South Carolina material to Burmeister, that in numerous cases Burmeister credits to Zimmermann. Rehn and Hebard discussed similar cases in endeavoring to determine definitely the exact locality from which such South Carolina material came in their studies of the genera *Orchelimum*[4] and *Atlanticus*.[5] It is known that Zimmermann sent material to both Burmeister and Germar, and that the Germar material was later acquired by Burmeister, and that in the process the name of the collector may not have been recorded. As shown in the above-mentioned Rehn and Hebard studies, until 1838 Zimmermann worked almost entirely in the vicinity of Georgetown, South Carolina, and this was probably the actual locality for the original material of *arenosa*.

Tettix blatchleyi Hancock. Based on two females, taken at Ormond, Florida, April 9, 1899, by W. S. Blatchley. Hancock's type, labelled "*Tettix blatchleyi* Hancock, Type" by him, and from his personal collection, is type no. H 664 in that of the Academy of Natural Sciences of Philadelphia. The paratype was probably returned to Blatchley, as he refers in 1920 to the "type" as being before him, and doubtless this is now with his material in the collection of Purdue University. Hancock's practice was to retain types of species he described unless a specific understanding was made to the contrary, and hence the specimen retained by him has a prior claim to be so regarded. It also has specific labelling and listing in his manuscript catalogue as the type.

It is clearly evident from the extensive material now available that *blatchleyi*, as represented by a number of Florida

[4] Trans. Amer. Entom. Soc., XLI, p. 34 (1915).

[5] Trans. Amer. Entom. Soc., XLII, p. 52, footnote 18 (1916).

series, is inseparable from individuals of *a. arenosa* from the Sabalian coastal areas of Georgia and the Carolinas. In 1916 Rehn and Hebard,[6] from the basis of a single female from Deep Lake, Florida, regarded *blatchleyi* as "merely an exaggeration of the *arenosum* [=*arenosa*] type." Blatchley, in 1920,[7] considered it a "southern form of *arenosum*" [=*arenosa*], but the characters given by him as diagnostic are without value when representative series are examined.

Tetrix arenosa angusta (Hancock) Text-figs. 1-4.

T[*ettix*] *angustus* Hancock, Trans. Amer. Entom. Soc., XXIII, p. 238, pl. VI, fig. 4, 4a, pl. IX, fig. 24 (1896) [♂, ♀; Bloomington and Riverside, Illinois].

T[*ettix*] *inflatus* Hancock, Trans. Amer. Entom. Soc., XXIII, p. 238, pl. VII, fig. 8, pl. IX, fig. 26 (1896) [♂, ♀; Riverside, Illinois].

T[*ettix*] *obscurus* Hancock, Trans. Amer. Entom. Soc., XXIII, p. 239, pl. VII, figs. 9, 9a, 10, 10a, pl. IX, figs. 23, 25 (1896) [Riverside, Illinois].

T[*ettix*] *gibbosus* Hancock, Trans. Amer. Entom. Soc., XXIII, p. 239, pl. VI, figs. 5, 5a, pl. VIII, figs. 14-19, pl. IX, figs. 30, 31a (1896) [Riverside and Rivergrove, Illinois].

T[*ettix*] *fluctuosus* Hancock, Trans. Amer. Entom. Soc., XXIII, p. 240, pl. VII, figs. 6, 6a, 6b, pl. IX, fig. 27a (1896) [Riverside and Rivergrove, Illinois].

T[*ettix*] *decoratus* Hancock, Trans. Amer. Entom. Soc., XXIII, p. 240, pl. VII, figs. 7, 7a, pl. IX, fig. 31 (1896) [Chicago, Riverside and Rivergrove, Illinois].

Tettix arenosus var. *costatus* Hancock, Tettig. N. Amer., pp. 38, 68 (1896) [No definite material or localities cited, but clearly based on this subspecies].

Tettix angustus Hancock. Based on an unstated number of specimens of both sexes from Bloomington and Riverside, Illinois, those from the former locality said to have been collected by M. J. Elrod, from the latter by J. L. Hancock, all originally in the Hancock Collection. Lectotype, ♀, Bloomington, Illinois, June 6, 1893, Acad. Nat. Sci. Phila. Type no. H 663. Labelled in Hancock's handwriting *T. angustus* on a printed "Hancock's Type 1896" label. Of the original Hancock material of *angustus* the A.N.S.P. series contains 6 ♂, 9 ♀ paratypes.

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[6] Proc. Acad. Nat. Sci. Phila., 1916, p. 133.

[7] Orth. N. E. Amer., p. 170

Tettix inflatus Hancock. Based on an unstated number of specimens of both sexes from Riverside, Illinois, without note of collector, but presumably taken by Hancock, and all originally in the Hancock Collection. The figured specimen, while not so indicated or distinctively labelled, is a female. Lectotype, ♀, Riverside, Illinois, October 16, 1893, Acad. Nat. Sci. Phila. Type no. H 660. Labelled "Hancock's type" (the former word printed, the latter in Hancock's handwriting), and also a printed "Tettix inflatus Hancock" label. Of the original Hancock material of *inflatus* the A.N.S.P. series contains 1 ♂, 1 ♀ paratypes.

Tettix obscurus Hancock. Based on the female sex, number of individuals not stated, from Riverside, Illinois, also without note of collector, but presumably collected by J. L. Hancock, and the relevant material was in the Hancock Collection. Lectotype, ♀, Riverside, Illinois, October 16, 1893, Acad. Nat. Sci. Phila. Type no. H 662. Labelled "Hancock's type" (the former printed, the latter in Hancock's handwriting), and also a printed "Tettix obscurus Hancock" label.

Tettix gibbosus Hancock. Based on an unstated number of females from Riverside and Rivergrove, Illinois presumably collected by Hancock, and in his collection. Lectotype, ♀, Riverside, Illinois, August 18, 1895, Acad. Nat. Sci. Phila. Type no. H 658. Labelled "Tettix gibbosus" in Hancock's handwriting on a printed "Hancock's Type, 1896" label. Two male and three female paratypes are also in the Academy series.

Tettix fluctuosus Hancock. Based on an unstated number of females from Riverside and Rivergrove, Illinois, presumably collected by Hancock and in his collection. Lectotype, ♀, Riverside, Illinois, June 12, 1894, Acad. Nat. Sci. Phila. Type no. H 659. Labelled with a printed "Tettix fluctuosus Hancock" label. A single female paratype is also in the Academy series.

Tettix decoratus Hancock. Based on an unstated number of females from Chicago, Riverside and Rivergrove, Illinois, presumably collected by Hancock, and in the Hancock Collection. Lectotype, ♀, Riverside, Illinois, September 27, 1893, Acad. Nat. Sci. Phila. Type no. H 661. Labelled "Hancock's Type" (the

former word printed, the latter in Hancock's handwriting) and also with a printed "Tettix decoratus Hancock" label.

Tettix arenosus variety *costatus* Hancock. This name appears only in a list of names and in a key, without any indication of localities represented save those given for "*arenosus.*" The localities listed for the latter all relate to *arenosa angusta* as here defined. The name *costatus* was applied to the brachypronotal phase, but no material bearing this varietal name was contained in the Hancock series when received by Mr. Hebard. Perhaps a later realization that applying names to such cases of intraspecific dimorphism was undesirable, and not good systematics, may have been responsible for Hancock's fai!ure to retain any indentifying labels which may have been on specimens he originally referred to this variety. In consequence there is no warrant nor certainty for designating a lectotype.

The identity of his *Tettix inflatus* and *angustus* with his *obscurus* was established by Hancock in 1902,[8] and also of his *fluctuosus* and *decoratus* with his *gibbosus.*[9] In 1916 Rehn and Hebard,[10] on the basis of page priority, utilized *angustus* rather than *obscurus* and also, on the same page, placed *gibbosus* as a synonym of *Tetrix arenosa angusta.* The present study confirms all the previously established synonymy, and makes evident that these names were based on morphological shadings of a very plastic subspecies. These shadings are not correlated in any way with possible geographic or clinal interpretations, and are frequently evident in the same population, as shown by the original localities and certain relevant Hancock comments.[11]

Dimorphism.—Prontotal dimorphism in this species is less well marked than in other forms of the genus investigated by us. Of the 3498 specimens recorded, only 364, approximately 10%, are of the brachypronotal type. No sexual correlation is indicated since approximately 50% of the short pronotum specimens are of each sex. There is a marked correlation between pronotal form and geographic placement and a north → south

[8] Tettig. N. Amer., p. 88.

[9] Ibid., p. 90.

[10] Proc. Acad. Nat. Sci. Phila., 1916, p. 134.

[11] Tettig. N. Amer., pp. 89, 91 (1902).

cline is clearly indicated for this character in the greater portion of the range. In this area (considering populations large enough to be significant) the percentage of brachypronotal specimens ranges from 41% of the Ontario population to 0% of the Texas, Mississippi and Alabama populations with only minor fluctuations in percentages as follows: Ontario 41%, Vermont 50%, New York 31%, Minnesota 16%, Michigan 19%, Pennsylvania 19%, Ohio 2%, Indiana 1%, Iowa 13%, Virginia 1%, Missouri 1%, North Carolina 6%, Tennessee 2%, South Carolina 1%, Oklahoma 3%, Georgia 2%, Alabama 0%, Mississippi 0%, Texas 0%. In the extreme south there appears to be a reversal of the cline with the Florida series showing a 16% brachypronotal rate and the Louisiana population with a 5% rate. The more western series do not exhibit this cline: South Dakota 9%, Nebraska 15%, Kansas 13%. These latter series, however, have a very high percentage of individuals with a much shorter than normal pronotal length. The Illinois population is distinctly aberrant, exhibiting a brachypronotal rate of 23%.

Stated generally, this species shows a diminution in pronotal length in a north → south direction except in its western distribution and in Illinois, and a reversal of this trend in Louisiana and Florida.

Size variation.—As is usual in tetrigids there is a great variation in individual size in this species. Table 1 records measurements taken from three populations representing both subspecies of *T. arenosa*. In each case eight individuals of each sex were chosen at random from the series. These were then measured and the measurements recorded.

Morphological variation.—Tetrix arenosa shows wide variation in a number of morphologic characters which are usually of taxonomic importance. The variation in pronotal surface and outline account for much of the synonymy discussed above. Other varying characters are: the width of the fastigium, the extent to which this structure is projected cephalad of the eyes, the outline of the frontal costa as viewed laterally and the size of the eyes. The characters separating the two subspecies of this species are discussed elsewhere. Accordingly, the species as a whole is treated in the following comments.

	Tetrix a. angusta				Tetrix a. arenosa	
	Gallia, Ohio		Elk Point, South Dakota		Gainesville, Florida	
	7.4	7.2	7.0	7.1	6.8	7.0
Length ♂	7.3	7.2	6.9	7.4	6.9	6.5
	6.9	7.6	6.8	7.2	6.3	6.7
of	6.9	7.4	7.4	6.9	6.4	6.4
	9.4	9.5	10.2	9.1	9.0	8.9
Body ♀	9.5	9.7	9.1	9.0	8.9	8.0
	9.7	9.6	9.6	9.6	8.4	9.2
	9.2	10.2	9.7	8.7	8.7	8.5
	10.2	10.7	8.4	9.9	9.5	9.7
Length ♂	9.6	10.1	9.4	8.9	10.5	10.0
	10.4	10.7	8.5	9.4	9.5	9.2
of	10.0	9.9	9.5	9.7	9.9	9.5
	11.4	11.6	11.6	11.2	11.8	12.0
Pronotum ♀	11.5	12.1	11.5	11.0	11.4	11.7
	10.1	11.1	11.1	12.1	11.3	11.5
	12.3	11.8	10.5	10.9	11.4	10.9
	.64	.62	.61	.58	.64	.61
Greatest ♂	.62	.67	.62	.66	.64	.64
	.64	.64	.61	.62	.59	.56
Breadth of	.59	.64	.64	.58	.59	.55
	.77	.80	.70	.74	.72	.72
Fastigium ♀	.67	.69	.72	.72	.72	.75
	.75	.78	.69	.75	.78	.75
	.75	.70	.74	.69	.74	.70
	.06	.06	.08	.10	.05	.05
Length ♂	.05	.05	.10	.10	.03	.05
of	.03	.06	.08	.06	.03	.05
Fastigium	.08	.05	.10	.08	.06	.03
Cephalad	.06	.11	.11	.10	.13	.08
of Eyes ♀	.08	.05	.13	.08	.10	.06
	.06	.10	.08	.10	.06	.11
	.08	.13	.06	.11	.06	.05
	4.6	4.8	4.8	4.7	4.7	4.8
Length ♂	4.8	4.8	4.6	4.8	4.8	4.5
of	4.9	5.3	4.5	4.8	4.5	4.7
Caudal	5.0	4.7	4.9	4.8	4.5	5.0
Femur	5.7	5.7	5.4	5.6	5.6	5.7
♀	5.6	5.8	5.5	5.6	5.0	5.4
	5.2	5.7	5.4	5.8	5.2	5.5
	6.1	6.0	5.5	5.4	5.0	5.4

Table 1. Size variation in three populations of *Tetrix arenosa*. The individuals (eight of each sex) were measured for the five characters which were then recorded in the same sequence under each of the major headings (body length, etc.). This makes it possible to locate all measurements made on any one of the specimens. All measurements are in millimeters.

The character of the pronotal surface varies from a smooth, finally granulose condition, such as that found in *T. subulata*, to a coarsely granulose or even gibbous, state. Occasionally, minute, longitudinal rugulae are evident. These extremes and the intermediate conditions are encountered in all the populations studied and indicate mere individual variation. They are

not regionally or sexually correlated. The usual pronotal condition encountered in the great majority of individuals is an almost even, shallowly concave dorsolateral outline. Almost always there is a weakly expressed convexity before the shoulders. Variations in this pattern are especially evident in the brachypronotal specimens which tend to have the outline plane (dorsally) rather than concave, and in which the prehumeral convexity is higher and much more strongly expressed. In one extreme variant, occasionally found in the more northern populations, there is a series of low convexities in the dorsal pronotal outline, giving it a fluctuating appearance. However, this is merely an expression of individual variation shown by a few specimens occurring in widely scattered populations.

The fastigial width, as seen from above, varies rather markedly. The extremes of this width are .67 mm. to .80 mm. in females, and .55 mm. to .67 mm. in males. The populations analyzed for this character along with the measurements recorded are shown in Table 1. Another variable feature of the fastigium is the extent of its production beyond the anterior border of the eyes. The extremes of variation are .05 mm. to .13 mm. in females and .03 mm. to .10 mm. in males. Measurements for representative populations are given in Table 1. Neither of these characters is correlated with distribution except in the case of the males from Gainesville, Florida, which have a shorter projection of the fastigium beyond the anterior border of the eyes.

In the lateral outline, the frontal costa shows variation in both the shape of its dorsal portion and the extent of the concavity in the area of the paired ocelli. Typically, the outline of the fastigio-facial area is that of an acutely rounded angulation. This varies with the extent of the fastigial projection anteriorly. Where the fastigium exceeds the anterior border of the eyes only slightly, the fastigio-facial angle tends to be nearer rectangulate-rounded and the emargination in the outline of the frontal costa is more shallow. The usual condition encountered in the species is illustrated in text-figs. 2, 4. There is no correlation with either sex or distribution and the occurrence of individuals showing extreme variations in this character, except as noted above (Gainesville, Florida males).

Eye size and the degree to which these organs protrude from the head varies in this species. The proportionately larger and more protuberant eyes are found in the southern race and serve as one of the characters which differentiates this subspecies.

Coloration, pattern and tone.—The general conclusions reached in our studies covering the other species of this genus [12] seem to apply equally well to *T. arenosa*. There is a wide range of color variation, both in pattern and tone, and no regional or sexual correlation is noted. The series studied has a greater number of light-colored individuals than of the fuscous or fuscous-black form. In this respect, i.e. being lighter colored, it most closely approaches *T. brunneri*, but the general tone is not so bright as in that species. A great many distinctive chromatomorphs are apparent, the most outstanding one being a light buff, ocherous or tan saddle across the interhumeral area of the pronotum. The species displays the paired, atrovelutinous pronotal blotches quite prominently and fully half or more of the individuals studied possess them. The following conclusions seem to apply to the series recorded herein:

1. Coloration is somber with the predominant tone being brown touched with gray or black. Many individuals are lighter in color being russet, tan or ashy gray.

2. The most conspicuous chromatomorphs bear a lighter colored interhumeral pronotal saddle.

3. No regional or sexual correlation is indicated with respect to coloration.

Distribution.—Unlike the other North American members of the genus, *Tetrix arenosa* is a relatively Austral type, and penetrates but narrowly to the westward of the eastern border of the Great Plains, and in some cases at least this intrusion into plains country has been from the east along the narrow wooded river valleys. To the northward of the United States it is known only from the Bay of Fundy side of Nova Scotia, from southern New Brunswick, certain localities in southern Quebec, and rather broadly over the inter-lake portion of southeastern Ontario, with

[12] See Rehn and Grant, Proc. Acad. Nat. Sci. Phila., CVII, pp. 1-34 (1955); ibid., pp. 145-165 (1955); CVIII, pp. 97-115, 117-153.

a single record from Manitoba.[13] Zonally typical *Tetrix arenosa arenosa* is a Sabalian Life-Zone species [14] as found in the southeastern United States, while similarly typical *T. arenosa angusta* is Transition (Alleghanian), Upper Austral (Carolinian) and Lower Austral (Austroriparian), narrowly intrusive into parts of the Boreal (Canadian) in northern Michigan and northern Minnesota.

Specifically defined, the area of distribution of *T. arenosa arenosa* covers all of peninsular Florida and westward in the remainder of the state to the region of the Apalachicola River, with certain representations from sections of northern Florida atypical or even intermediate between *T. a. arenosa* and *T. a. angusta*. In inland southern Georgia typical *T. a. arenosa*, as well intermediate material, is before us from as far north as Cox (Dodge Co.) and Macon (Bibb Co.). The distribution of *T. a. arenosa* follows narrowly northeast over the coastal region of eastern Georgia and the Carolinas as far as Wrightsville in southeastern North Carolina, this being the most northern point from which we know the typical subspecies. Localities in the upper coastal plain or portions of the Piedmont of the Carolinas are represented by material intermediate between the two subspecies, thus showing a segment of the area of intergradation, these being Columbia and Florence, South Carolina, and Lake Waccamaw, Southern Pines, Raleigh and Charlotte, North Carolina, with typical *T. a. arenosa* also occurring at Lake Waccamaw. From certain mountain areas of western North Carolina we have seen individuals which are clearly intermediate between the two subspecies, a situation which is difficult to explain except by the postulate that what we see is a reflection of an interglacial or postglacial period when greater warmth may have given *T. a. arenosa* a much broader distribution, and that

[13] A single specimen labelled "Forty Mile, Yukon Territory" is in the Academy collections. We know nothing of its history, and in the absence of any supporting information on the presence of the species elsewhere in the vast area of northwestern Canada, or from equally Boreal parts of eastern Canada, we can only conclude some error or transposition has been made in the labelling. Accordingly it has been ignored in the accompanying mapping, and is not included in the listing of localities.

[14] For discussion of this well-marked life area, see Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1916, pp. 101-110, fig. 3 (1916).

this tendency has persisted in limited areas, although completely encompassed by territory now inhabited by *T. a angusta.*

Another angle of great interest in the distribution of *T. a. arenosa* is that we find material which is atypical of that subspecies at several localities in the central section of the coastal region of Texas, these being Victoria and Bay City, although to the northeast at Houston the representatives are atypical *a. angusta*, with both typical and atypical individuals of the same subspecies before us from Polk Co., Texas. This type of discontinuous distribution in south coastal Texas and peninsular Florida is parallel by that of *Orphulella halophila* Rehn and Hebard, a discussion of which is given in the original description of the latter.[15] Gurney in a subsequent study of the genus *Orphulella* [16] has regarded *halophila* as a geographic race of *olivacea*, a conclusion which places that problem in exactly the same relationship and type of discontinuous distribution as here discussed for the components of *T. arenosa.* However, no material of this group of the genus *Tetrix* is available from Mexico—in fact it has never been reported from that country—so we are unable to advance any suggestion as to how far south *T. a. arenosa* may occur.

The distribution of *T. a. angusta* is much more extensive than *T. a. arenosa*, and the former exceedingly plastic subspecies apparently has been able to maintain itself, and even extend its range broadly, probably with temperature and humidity the controlling barriers, i.e. on the north by temperature, and on the west by increasing aridity. The clearly established extreme points of its distribution to the northward are Aweme, southern Manitoba; Warroad, Roseau Co., Minnesota; Alston, Houghton Co. and Pequaming, Baraga Co., Michigan; Owen Sound, Lake Simcoe and Marmora, Ontario; Danforth Lake and Maniwaki, Quebec; Bingham, Somerset Co., Maine; Fredericton, New Brunswick; and Truro, Nova Scotia: to the westward, Aweme, Manitoba; Dupree, Ziebach Co., and Rosebud, Todd Co., South Dakota; Rawlins and Sumner Cos., Kansas; Logan and Murray Cos., Oklahoma; Waco, McLennan Co., Tiger Mills, Burnet Co.,

[15] Proc. Acad. Nat. Sci. Phila., 1916, pp. 166-170 (1916).

[16] Entom. Americana, xx (new series), pp. 108-116 (1940).

Kendalia, Kendall Co., and Selma, Bexar Co., Texas. Southward *T. a. angusta* in its typical condition broadly reaches the Gulf Coast area in the stretch between Beaumont, Jefferson Co., Texas and Mobile, Alabama.

The line of intergradation between the two subspecies extends from the Apalachicola River area of the Florida "panhandle" northeastward across south-central Georgia and along or just below the "Fall Line" of the two Carolinas, with no intermediates seen in this direction from north of Raleigh, Wake Co.,

Map 1.—Map showing the distribution of *Tetrix arenosa*: filled circles = *Tetrix arenosa angusta*; half-filled circles = intermediates between *Tetrix arenosa angusta* and *Tetrix arenosa arenosa*; open circles = *Tetrix arenosa arenosa*.

North Carolina. Material from northeastern North Carolina, i.e. Tunis, Hertford Co., and Hertford, Perquimans Co. is typical *T. a. angusta*, as is all material from thence northward to Nova Scotia. We have already discussed under *T. a. arenosa* the occurrence of intermediate material from several localities in Watauga Co. (Valle Crucis) and Haywood Co. (Crestmont), western North Carolina.

Habitats.—As we have already emphasized in discussing the habitats of *Tetrix subulata*,[17] that conclusions apropos the same, drawn from studies in one limited or circumscribed area, may not be at all applicable in another, and consequently may supply but a part of the picture for the whole range of the species. Blatchley in 1903,[18] regarding Indiana, said this species "frequents uplands woods which are dry and open, being seldom seen in the vicinity of water," although in 1894 [19] he had said of it in the same state, "occasionally in company with *T.* [*Paratettix*] *cucullatus* about the borders of streams," while Morse [20] in 1920 gives its habitats for New England as, "damp spots on fields of sandy loam, roadsides through springy land, and wet, sandy humus generally." Hancock [21] observed that heavy rain "had the effect of driving the tettigids [specifically this one] away from the immediate vicinity of the river to open woods," and adds further, "at the roots of large oak trees where the soil was interspersed with fine gravel, a number . . . were found." Cantrall in 1943,[22] on the basis of his studies at the George Reserve, Michigan, strongly inclines to the belief that most of the previous statements regarding particular habitats for this species, and specifically *T. a. angusta*, were based on "erratics," a possibility which he states "becomes a probability in the light of my observations on the fall dispersal of these insects." He reviews certain statements by previous authors on the frequented

17 Proc. Acad. Nat. Sci. Phila., CVII, p. 156 (1955).

18 27th Ann. Rep. Dept. of Geol. Nat. Res. Indiana, p. 225.

19 Canad. Entom., XXVI, p. 220.

20 Proc. Boston Soc. Nat. Hist., 35, p. 534.

21 Tettig N. Amer., p. 90 (1902).

22 Misc. Publ. Mus. Zool. Univ. Mich., no. 54, pp. 81-82.

habitats of the species, which range from "dry open places varying from sandy banks of streams to the open prairie of the Red River Valley [, Minnesota]" from Somes, "sandy beach, moist at the water level [Illinois]" from Hart and Gleason, and gives, from several of Hancock's papers quotations which show he collected the species near a dense woods which is swampy in the spring, and where "the soil is light clay covered with weeds, mosses, lichens and other usual flora common to damp situation." Cantrall also quotes from Hubbell's 1922 Berrien County, Michigan paper to the effect that *T. a. angusta* was found "living in a variety of situations, such as sand and mud shores, margins of ponds, a dry sandy clay road at the margin of a second growth woods, mud-bar and sand-bar herbage, moist muddy patches in flood-plain forest, and the mucky margins of a pool at the edge of a buttonbush swamp in the Galien River flood plain." He further quotes from Fox, 1917, that in Virginia [not Georgia as Cantrall states] the species has a "marked preference for patches of bare damp earth, occurring in open woodland and in open grassy pastures."

There is a considerable amount of published habitat information for areas other than the Central States to which Cantrall has made no reference, and much of it cannot be dismissed as based on "erratics." Rehn and Hebard, in 1905, regarding Thomas County, Georgia captures[23] stated, "this species is found common in the vicinity of water, on sandy beaches and wet soil, but probably is local in its distribution even in such environment, as it was taken at but three points. In a piece of bayou country, amid cypress and black gum, on the Ocklockonee River west of Thomasville this species [*T. a. arenosa*] was [also] taken." Isely, in 1905,[24] reported it from Kansas "on a moist sandy bank," while Morse, in 1907,[25] recorded material, now known to be of *T. a. angusta*, from northern Georgia, Alabama, Mississippi, Arkansas, Oklahoma and northern Texas, as "usually on sandy loam." Rehn and Hebard in 1916,[26] re-

[23] Proc. Acad. Nat. Sci. Phila., 1904, p. 781.

[24] Trans. Kansas Acad. Sci., XIX, p. 240.

[25] Carnegie Inst. Wash. Publ. no. 68, pp. 25-26.

[26] Proc. Acad. Nat. Sci. Phila., 1916, pp. 133-134.

ported it from "wet clay along a 'branch' in pine woods" at Charlotte, No. Carolina, "on dry, sandy soil in open forest of short-leaf pine" at Wrightsville, No. Carolina, and "sandy shores" at Lake Waccamaw, No. Carolina (the material from the last two mentioned points being *T. a. arenosa* and intermediate between *T. a. arenosa* and *T. a. angusta*). Piers, in 1918,[27] stated that in the neighborhood of Truro, Nova Scotia "this species is very common," and that "it occurs mostly along the banks of streams and in boggy places." Knutson, relative to Iowa habitats, said, in 1937,[28] it occurs "in open timothy pastures . . . in abundance along the fence of a level wheat field," and further that "in both instances the specimens were taken at least a mile from water." Urquhart, in 1941,[29] states that at Point Pelee, Ontario it was found in June in "moist situations in the open clearing of the hardwood forest" there, and Froeschner, relative to Iowa, said in 1954,[30] the species was found in "woods and dry, somewhat sparsely weeded fields . . . only uncommonly found close to water." Friauf, in 1953,[31] regarded typical *arenosa* in the Welaka Reserve, Florida, as a form of what he termed the "low hammock habitat," and also of "the alluvial hammock habitat," and Blatchley in discussing *blatchleyi* (which is a synonym of *T. a. arenosa*), at Dunedin, Florida,[32] said it was taken "by sweeping a recently cleared space . . . on the former site of a wet hammock, and still in great part surrounded by a dense hammock growth."

The many unpublished field observations on this species made by Rehn and Hebard or by the former alone over a number of decades give a broad picture of the adaptability of the species. True *a. angusta* was taken at De Leon Springs, Florida in a heavy oak hammock with dry sandy soil, much cabbage palmetto and vines, at Fort Myers, Florida, on bare black muck in a cypress

27 Trans. Nova Scotia Inst. Sci., XIV, p. 263.

28 Field and Laboratory, V, p. 39.

29 Contrib. Royal Ont. Mus. Zool., no. 20, p. 23.

30 Iowa State Coll. Journ. Sci., 29, p. 199.

31 Ecological Monographs, 23, no. 2, p. 122.

32 Orth. N. E. Amer., p. 170 (1920).

swamp, and on similar mucky ground in dense "branch" forest of deciduous trees at Bainbridge, Ga. The typical subspecies thus seems much less adaptable and more restricted in its ecological preferences than its more northern analogue *T. a. angusta*. The latter was taken along the strand of the Delaware River at Cornwells, Pa., in moderate numbers on damp ground with moss on the edge of deciduous forest at Gwynedd, Pa., on roadsides in decidous forest (East base of Warrior Ridge, Pa.), in open woods of oak, maple, hemlock and white pine (2 ms. S. of Mechanicsville, Pa.), in roadside drain near open forest of loblolly pine, tulip and sweet gum (between Eastville and Cheriton, Va.), in heavy mixed forest (Brushy Mtn., Va.), and on the ground of wooded slopes (Clinchfield and on the south slope of Walker Mtn., Va.). In the Southeastern States, exclusive of Florida, east of the Mississippi River typical *T. a. angusta*, as well as intermediates between it and *T. a. arenosa*, have been taken in a great variety of situations, such as on bare ground in heavy deciduous forest of sweet gum, hickory, oak and beech (Selma, Ala. and George Mtn., Dillard, Ga.), in short grasses in long-leaf pine woods (Mobile, Ala.), in dead leaves in rather open woods of long-leaf pine with some undergrowth of oak sprouts and *Myrica* (Hattiesburg, Miss.), on bare ground in oak groves near stream (Jackson, Miss.), on similar surface in dense deciduous swamp forest (Strickton, Greenville and Winona, Miss.), on ground of roadside slopes (Between Topton and Robbinsville, N. C.), on wet clay along "branch" in pine woods (Charlotte, N. C.), on sandy area on edge of bog (Stone Mtn., Ga.), numerous in sandy areas of rolling pine and deciduous forest country (Opelika, Ala.), from ground in deciduous forest (Brasstown Gap, Ga.), and from grassy roadside (Balsam Gap, N. C.). Near Wasioto, Kentucky it was found in low cover along roadside border of mixed deciduous forest, also in a logged woodland patch with limb debris, deciduous saplings, golden rod, sumac, smilax and other thicket growth (5 ms. SW. of Corbin, Kent.), and on ground both bare and with dead leaves in open deciduous forest between Madisonville and Gudger, Tenn. In Arkansas it has been found in low open deciduous forest with heavy undergrowth (6 ms. E. of Fairoaks), taken on the ground

in scrubby deciduous and juniper woodland (4 ms. SW. of Mountain View), and from open deciduous woods with moderately heavy undergrowth (10 ms. S. of Jasper). In Louisiana it was taken on mucky ground in swampy area of cypress and tupelo (Morgan City), found infrequent in wet areas in long-leaf pine woods and adjoining open prairies (Le Bleu Settlement), in deciduous forest with clumps of heavy undergrowth and areas of tall grass with scattered saw palmetto (Bee Bayou), on the ground in a river bank forest of sweet gums, oak, etc. (West Monroe), and among leaves in a "branch" of magnolia and oaks with much grass and high undergrowth (Alexandria). At Houston, Texas it was moderately numerous on the bare sandy bottom of a dry stream bed in oak and pine groves.

It is thus evident that *T. a. angusta* frequents a broad variety of environments, generally where a certain amount of moisture is present, but this is not an overall requirement. Also any broad assumption that the material taken in a number of these situations represent "erratics" seems quite unwarranted, and seasonal shifts do not explain the varied pattern, as the dates of capture cover a considerable period. In this respect *T. a. angusta* is apparently far more adaptable than the more restricted *T. a. arenosa*, as could be expected from the more variable climatic conditions it must encounter. There is also the possibility this may reflect the vicissitudes inherent in the postglacial history of much of the country over which it is distributed.

Seasonal Appearance.—A detailed analysis of the available information relative to the dates of appearance of the two subspecies of *T. arenosa* makes evident that over the greater part of its distribution the species appears to have but a single annual brood, but in Florida and in some immediately adjoining territory in southern Georgia it is very probably two-brooded and occurs actively in the adult condition through all or virtually all the whole year. From Canada the earliest date we have for adults is April 4 (Toronto), while Ottawa is represented by April 27 material, and adults are before us from Aweme, Manitoba taken as early as May 28. The earliest New England dates for adults are April 17 (Brattleboro, Vt.) and 28 (Clarendon, Vt.), while they are before us from dates as late as October 4 (New Canaan,

Conn.), and adults and immature individuals were taken September 8-10 at Wesquage Beach, R. I. From the Middle Atlantic States we have seen little adult material taken before April, the few March captures being from Hummelstown, Pa. (March, no date) and Charlottesville, Va. (March 28), while April is represented by dates covering the entire month on material taken in New York (Ithaca, McLean and Yonkers), New Jersey (Riverton), Pennsylvania (Beatty, State College, York, Dismal Run, Lester, Villa Nova, Ashbourne, Lawndale, Chestnut Hill and Philadelphia), Maryland (Bald Friar and Takoma Park), District of Columbia (Washington), and Virginia (Charlottesville, Bull Run, Tappahannock, Colonial Beach, W. of Homeville, 3 ms. S. of Adams Grove, Fountain Creek, James River Junction and James River W. of Varina). Adults and immature individuals are before us taken August 14 (Gibbstown, N. J.), and September 7 (Cornwells, Pa.), while immature specimens alone were taken in April at Washington, D. C., and August 19 at a point 2 ms. N. of Sugar Grove, Pa. The last dates represented by adult material from the Middle Atlantic States are October 5 (Rockaway Beach, N. Y.), 13 (Plummer's Island, Md.), 20 (Ashbourne, Pa.), 22 (Vincentown, N. J.) and 27 (Great Falls, Va.).

In the South Atlantic States we find adults taken as early as February 1 and 8 (Florence, S. C.), 22 (Macon, Ga.) and 29 (Thomasville, Ga.), while immature individuals represent dates as early as March 19 (Faceville, Ga.), and April 5 (Macon, Ga.), and adults and immature specimens were taken as early as April 13 (Macon, Ga.) and as late as August 23 (4.8 ms. S. of Sealy, Ga.), and September 5 (Bainbridge, Ga.) and 7 (Wrightsville, N. C.). The latest dates we have for adults in this section are December 10 (Macon, Ga.) and 18 (Thomasville, Ga.). It is thus evident that in south-central and southern Georgia the species is present adult over most, if not all, of the year, and there apparently two-brooded. In the Central States we find a very broad range in occurrence as adults, as evidenced by the material before us, with dates as early as January 2 (Urbana, Illinois), although most of the first captures are in March or April, viz. March 3 (Marion Co., Ind.), 17 (Colerain Twp., Ohio), 21 (Fulton, Kent.), 26 (Plattsmouth, Nebr.), and

28 (Willard, Mo.), April 1 (Washtenaw Co., Mich.), 3 (Ann Arbor, Mich.), 14 (Lawrence, Kansas), 20 (Corn Creek, Minn.), and 22 (Ames, Iowa). Immature individuals from the same area were taken unaccompanied by adults as early as July 17-21 (Princeton, Minn.), and adults and immature representatives are before us taken April 28 (Rice Creek, Minn.), May 29 (Douglas Lake, Mich.), June 1 (Ann Arbor, Mich.), 21 (St. Joseph, Mich.), and August 28 (Oscoda, Mich.) and 29 (Burt Lake State Park, Mich.). The last dates for adult captures in the extensive Central States representation before us are: September 18 (Nr. Black Lake, Mich.), and 27 (Pipestone, Minn.), October 1 (Vermillion, S. D.), 3 (Montello, Wisc.), 4 (Vigo Co., Ind.), 10 (Lawrence, Kansas), 24 (Pulaski, Ill.), 25 (Atherton, Mo.), 29 (Gambier, Ohio), 30 (Columbus, Ohio), November 3 (Lincoln, Nebr.), and December 7-12 (Henry Co., Iowa).

In Florida, where typical and (in certain northern sections) atypical *T. a. arenosa*, and material intermediate between the two subspecies (also found in certain of the northern areas) occurs, the species is clearly two-brooded and active in the adult condition throughout the year, as the series before us contains the same for all twelve months. We have examined immature individuals unaccompanied by adults taken as early as January 5 (Deer Lake) and as late as September 5 (Welaka), with adults and immatures taken together in March, i.e. 3 (Royal Palm State Park), 16 (San Felasco Hammock) and 31 (Hague) and on September 13-15 (Fort Myers).

To summarize, like *T. subulata* and *ornata*, the species apparently is single-brooded in the northern section, and most of its range, but two-brooded in the southeastern section. The incidence of collecting, and its often seasonal character, makes it difficult to determine exactly where the passage from a single-brooded to a double-brooded condition may occur, although very probably in Georgia the species is single-brooded in the colder northern portion and double-brooded in the south. Apparently the point of passage does not conform to that of the intergradation of the two subspecies, but is not widely removed from that area.

Localities represented.[33]

Typical *Tetrix arenosa arenosa*

North Carolina: *Wrightsville (New Hanover Co.). *Lake Waccamaw (Columbus Co.).

South Carolina: Loris (Horry Co.).

Georgia: Cox (Dodge Co.). Valdosta (Lowndes Co.). *Mixon's Hammock, Okefenokee Swamp. *Thomasville (Thomas Co.). *Ocklockonee River, near Thomasville (Thomas Co.). *Spring Creek (Decatur Co.). 3 ms. S. of Faceville (Decatur Co.). *Bainbridge (Decatur Co.). Sealey's Spring (Seminole Co.)

Florida: Wakulla Springs (Wakulla Co.). *Jacksonville (Duval Co.). St. Augustine (St. Johns Co.). Anastasia Island, St. Augustine (St. Johns Co.). De Leon Springs (Volusia Co.). Welaka (Putnam Co.). *Welaka Reserve (Putnam Co.). Crescent City (Putnam Co.). Alachua Co. Gainesville (Alachua Co.). Prairie Creek, Gainesville (Alachua Co.). Lake Alice, Gainesville (Alachua Co.). 6 ms. W. of Gainesville (Alachua Co.). Newnan's Lake (Alachua Co.). 6 ms. W. of Newnan's Lake (Alachua Co.). Levy Lake (Alachua Co.). High Springs (Alachua Co.). Poe Spring (Alachua Co.). Hague (Alachua Co.). San Felasco Hammock (Alachua Co.). Juniper Springs, Ocala Nat. Forest (Marion Co.). Levy Co. 5 ms. N. of Sumner (Levy Co.). *Ormond (Volusia Co.) [type of *blatchleyi*]. Leesburg (Lake Co.). *Fort Reed (Orange Co.). Tarpon Springs (Pinellas Co.). *Dunedin (Pinellas Co.). Deer Lake (Hillsborough Co.). Plant City (Hillsborough Co.). Manatee (Manatee Co.). Myakka River State Park (Sarasota Co.). Palmdale (Glades Co.). Fort Myers (Lee Co.). *La Belle (Houdry Co.).[34] Fort Lauderdale (Broward Co.). *Deep Lake (Collier Co.).[35] Royal Palm State Park (Collier Co.).

Atypical *Tetrix arenosa arenosa*

Florida: *Marianna (Jackson Co.). Rock Bluff Landing (Liberty Co.). Liberty Co. Madison (Madison Co.). Allapaha River (Hamilton Co.). Columbia Co.

Texas: Victoria (Victoria Co.). Bay City (Matagorda Co.).

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[33] Certain of the older records of *Tetrix arenosa*, under various generic combinations, we have been compelled to disregard in delimiting or mapping the range of the component subspecies. Without the same material, or a representation from the same locality, no other course is possible. Where there could be no question as to the subspecies represented by the originally reported material we have utilized the record in our mapping and listing. In some cases none of the material originally reported is still in existence. An asterisk before a locality indicates that it had been previously published.

[34] Recorded by Blatchley as *blatchleyi* (Orth. N. E. Amer., p. 170 (1920)).

[35] Recorded by Rehn and Hebard (Proc. Acad. Nat. Sci. Phila., 1916, p. 133) as *blatchleyi*.

Intermediate Between *T. a. arenosa* and *T. a. angusta*

North Carolina: Valle Crucis (Watauga Co.). Crestmont, 2100, 3200 and 3500 ft. (Haywood Co.). Charlotte (Mecklenburg Co.). *Raleigh (Wake Co.). Southern Pines (Moore Co.). *Lake Waccamaw (Columbus Co.).[36]

South Carolina: Columbia (Richland Co.). Florence (Florence Co.).

Georgia: Macon (Bibb Co.). *Vienna (Dooly Co.).[36] Cox (Dodge Co.). *Spring Creek (Decatur Co.).[36]

Florida: 9 ms. S. of junction of Florida highways 20 and 67 (Liberty Co.). Twp. 2 N. 7 W. (Liberty Co.). Torreya State Park (Liberty Co.). "Camp Torreya," twp. 2 N. 7. W. (Liberty Co.). "Old Torreya" (Liberty Co.). (Northern border) Leon Co. Lake Jackson (Leon Co.). 2 ms. W. of Tallahassee (Leon Co.). Tallahassee (Leon Co.). Lake Mickosukee (Jefferson Co.).

Typical *Tetrix arenosa angusta*

Localities represented.[37]

Nova Scotia: *Truro (Colchester Co.). *Hants Co. *Kings Co. *Annapolis Co. *Yarmouth Co.

New Brunswick: Fredericton.

Quebec: Kazabazua. Maniwaki. Danford Lake. Ile de Montreal. Montreal. Landraie.

Ontario: Ottawa. Marmora. *De Grassi Point. *Owen Sound. *Goderich. Singhampton. *Lake Simcoe. *Toronto. Eglington. Agincourt. Grimsby. Sarnia. Rondeau. *Point Pelee. Miner's Bay.

Maine: *Cherryfield (Washington Co.). *Orono (Penobscot Co.). *Bingham (Somerset Co.). *Fryeburg, *Paris, Norway (Oxford Co.). Augusta (Kennebec Co.). Bath (Sagadahoc Co.).

Vermont: Lyndon (Caledonia Co.). Thetford (Orange Co.). Woodstock, Hartland (Windsor Co.). *Newport (Orleans Co.). Brattleboro (Windham Co.). Clarendon (Rutland Co.).

New Hampshire: Franconia, Warren (Grafton Co.). Manchester (Hillsborough Co.).

Massachusetts: Greenfield, Mt. Toby (Franklin Co.). Northampton (Hampshire Co.). Milton, Blue Hills (Norfolk Co.). *Nantucket (Nantucket Co.).

Rhode Island: Kingston, Wesquage Beach (Washington Co.).

Connecticut: New Canaan (Fairfield Co.). *New Haven (New Haven Co.).

New York: Peru and *Fort Montgomery (Clinton Co.). Hamburg (Erie Co.). *Genessee Co. *Ithaca, McLean, Malloryville and *Tarbel

[36] Recorded by Rehn and Hebard (Proc. Acad. Nat. Sci. Phila., 1916, p. 133) as *arenosa arenosa*.

[37] See comments in footnote 33.

(Tompkins Co.). *Lake Keuka (Steuben Co.). *Rock City (Saratoga Co.). *Debruce (Sullivan Co.). Poughkeepsie (Dutchess Co.). Florida and *West Point (Orange Co.). *Nyack, *Pearl River, *Ramapo and *West Nyack (Rockland Co.). Armonk, Pocantico Hills, Yonkers and *White Plains (Westchester Co.). Mosholu and *Van Cortland Park (Bronx). *Cold Spring Harbor and *Orient (Suffolk Co.). *Rockaway Beach (Queens Co.). *Wyandanch, L. I. *Staten Island.

PENNSYLVANIA: 2 mi. S. of Mechanicsville (Clarion Co.). Delaware Water Gap (Monroe Co.). State College (Center Co.). Coles Creek (Columbia Co.). *Washington (Washington Co.). Beatty (Westmoremoreland Co.). Hummelstown (Dauphin Co.). Villa Nova, Ashbourne, Gwynedd, Fort Washington, Edgehill, *Glenside, Wyncote (Montgomery Co.). New Cumberland (Cumberland Co.). Hillchurch, Cornwells, Lawndale (Bucks Co.). Warrior Ridge 3 mi. N. of Black Valley Gap (Bedford Co.). Buena Vista Springs (Franklin Co.). Walnut School Grove 1 mi. SW. of Abbottstown (Adams Co.). York (York Co.). Valley Forge, Phoenixville (Chester Co.). Serpentine Barrens at Pink Hill, Adele, Dismal Run, Lester, Castle Rock (Delaware Co.). Mt. Airy, Philadelphia, Chestnut Hill (Philadelphia Co.).

NEW JERSEY: *Ogdensburg (Sussex Co.). *Belvidere (Warren Co.). *Greenwood Lake (Passaic Co.). Boonton (Morris Co.). *Fort Lee, *Ramsey (Bergen Co.). Summit (Union Co.). Milltown (Middlesex Co.). Point Pleasant, *Stafford's Forge (Ocean Co.). Vincentown, *Riverton, Rancocas (Burlington Co.). Winslow Jct., Clementon (Camden Co.). Gibbstown, *Malaga (Gloucester Co.). Husted (Cumberland Co.). Bennett, *Cape May, Cedar Springs, Sea Isle City (Cape May Co.).

DELAWARE: Cheswold (Kent Co.).

MARYLAND: Jennings (Garrett Co.). Bald Friar, Rocksprings (Cecil Co.). *Laurel (Prince George Co.). Takoma Park, Silver Spring, Plummer's Island (Montgomery Co.). Chesapeake Beach (Calvert Co.). Priest Bridge.

DISTRICT OF COLUMBIA: Washington.

WEST VIRGINIA: Timber Ridge, 1.5 mi. E. of Capon Bridge (Hampshire Co.). Nr. Moorefield (Hardy Co.). Cabwaylingo State Forest (Wayne Co.). Cowan.

VIRGINIA: Rest (Frederick Co.). *Luray (Page Co.). Bull Run (Loudoun Co.). Difficult Run, Great Falls (Fairfax Co.). *Glencarlyn and *Chain Bridge (Alexandria Co.). McDowell (Highland Co.). Collison Ridge, *Hot Springs, *Healing Springs, *Little Mt., Warm Springs Ridge (Bath Co.). James River, Indian Point (Prince George Co.). Charlottesville (Albemarle Co.). Colonial Beach (Westmoreland Co.). *Tappahannock (Essex Co.). *Buckingham Co. *Wingina (Nelson Co.). James River, W. of Varina (Henrico Co.). 2 mi. E. of Covington (Alleghany Co.). Btwn. Eastville and Cheriton (Northampton Co.). Mt. Lake, Biol. Sta. (Giles Co.). *Roanoke (Roanoke Co.).[38] Blacksburg (Montgomery

[38] Recorded by Morse (Publ. 18, Carnegie Inst. Wash., pp. 25 and 26 (1904) and Pub. 68, Carnegie Inst. Wash., p. 25 (1907)) as *Tettix arenosus*.

Co.). 4 mi. No. of Chatham Hill (Smyth-Tazwell Cos.). Walker Mt. (Bland Co.). W. of Homerville (Sussex Co.). 2 mi. N. of Sugar Grove (Smyth Co.). Clinchfield (Russell Co.). Lee Co. Hopeville Gap, Fountaine Creek, W. Dahlia, James River Jct. (Greensville Co.). Nottoway River, N. W. of Courtland, near Meherin River, 3 mi. S. of Adams Grove (Southampton Co.). Fry's Springs. Garman's Gap.

North Carolina: *Roan Mountain Crestmont, 1600, 1700, 1800, 3500, 3500-4000, 4200 and 5600 ft. (Haywood Co.). *Pineola (Avery Co.).[38] *Asheville (Buncombe Co.). *Sulphur Springs, near Asheville (Buncombe Co.). Black Mountains (Buncombe Co.). Between Topton and Robbinsville (Graham Co.). Balsam Gap (Jackson-Haywood Cos.). 8.9 ms. W. of Franklin (Macon Co.). Highlands (Macon Co.). "Horse Cove," near Highlands (Macon Co.). Salisbury (Rowan Co.). *Charlotte (Mecklenburg Co.).[36] *Tryon (Polk Co.) *Tunis (Hertford Co.).[38] Hertford (Perquimans Co.).

South Carolina: CCC Camp F2 (Oconee Co.). Clemson (Oconee Co.). *Spartanburg (Spartanburg Co.).[36]

Georgia: Brasstown Gap, 2 ms. NE. of Young Harris, 2216 ft. (Towns Co.). Enotah Bald, Hiwassee (Towns Co.). 4.8 ms. SW. of Scaly (Rabun Co.). George Mountain, Dillard, 2400-2800 ft. (Rabun Co.). *Clayton, 2000 ft. (Rabun Co.). *Black Rock Mtn., 2000-3500 ft. (Rabun Co.). *Sand Mountain, near Trenton (Dade Co.).[38] Thomas (Floyd Co.). Atlanta (Fulton Co.). Buckhead (Fulton Co.). Vicinity of Stone Mountain (De Kalb Co.).[36] Clarke Co. Athens (Clarke Co.). Macon (Bibb Co.).

Michigan: Alston (Houghton Co.). Pequaming (Baraga Co.). Hughitt-Rawson Preserve (Gogebic Co.). Schoolcraft Co. Bois Blanc, St. Ignace, Grosse Point, Naubinway (Mackinac Co.). Waugoshance Island (Emmett Co.). Indian River, Cheboygan, Burt Lake State Park, Douglas Lake (Cheboygan Co.). Nr. Black Lake (Presque Isle Co.). Hog Island, High Island, Garden Island, Boyne Falls, Gull Island, Beaver Island (Charlevoix Co.). Marion Island (Grand Traverse Co.). Kalkaska Co. Crawford Co. Roscommon Co. Ogemaw Co. Oscoda (Iosco Co.). Scottville (Mason Co.). Clare Co. Loon Lake (Lake Co.). Gladwin Co. Hart (Oceana Co.). Midland Co. 2.6 mi. SW. of Lennon (Shiawasee Co.). Macatown Beach (Allegan Co.). East Lansing (Ingham Co.). Scio Twp., Iosco Twp., *E. S. George Reserve (Livingston Co.). Farmington (Oakland Co.). South Haven (Van Buren Co.). Ann Arbor, Rawsonville, Willow Run, Dexter (Washtenaw Co.). *Cassopolis (Cass Co.). Lakeside, St. Joseph, *E. K. Warren Preserve (Berrien Co.). *Sawyer Dunes (Berrien Co.). Ravine River.

Ohio: St. Joseph Twp. (Williams Co.). Sylvania, Swanton Twp. (Lucas Co.). Lakeside, Put-in-Bay (Ottawa Co.). Little Mountain, Grand River (Lake Co.). Morgan Twp., Trumbull Twp. (Ashtabula Co.). Defiance Twp. (Defiance Co.). Florida (Henry Co.). Amherst Twp. (Lorain Co.). Benton Twp., Crane Twp. (Paulding Co.). New Haven, Richmond Twp.

(Huron Co.). Richland Twp., Bluffton (Allen Co.). Mendon (Mercer Co.). Wooster (Wayne Co.). Washington Twp. (Morrow Co.). Paint Twp., Prairie Twp. (Holmes Co.). Perry Twp. (Logan Co.). Big Darby, Marysville (Union Co.). Berlin Twp., High Banks Met. Park, Red Hills (Delaware Co.). Gambier, Union Twp. (Knox Co.). Newcastle, White Eyes Twp., Cavallo (Coshoctan Co.). Perry Twp. (Tuscarawas Co.). Mad River Twp. (Champaign Co.). Clinton Twp., Indian Run, Norwich Twp., Bum Lake, Clintonville, Columbus (Franklin Co.). Harrison Twp., Granville, Union Twp., Bowling Green Twp., Fallsburg, Buckeye Lake (Licking Co.). Liberty Twp. (Guernsey Co.). Colerain Twp. (Belmont Co.). Perry Twp. (Montgomery Co.). Derby, Madison Twp., Jackson Twp. (Pickaway Co.). Lancaster, Rushville, Crystal Springs, Violet Twp., Berne Twp., Greenfield Twp. (Fairfield Co.). Mad Twp., Thorn Twp., Bristol Twp. (Perry Co.). Malta Twp. (Morgan Co.). Summerfield, Enoch Twp. (Noble Co.). Adams Twp. (Monroe Co.). Clifton, Camp Clifton (Greene Co.). Wayne Twp., Madison Twp. (Fayette Co.). Reilly Twp. (Butler Co.). Ft. Ancient (Warren Co.). Colerain Twp., Chillicothe, Liberty Twp., Bainbridge (Ross Co.). The Gulf, Conkles Hollow, Good Hope Twp., Laurel Twp., Rock House, Benton Twp., Neotoma, Buck Run, Sugar Grove, Salt Creek Twp. (Hocking Co.). Lake Hope, McArthur (Vinton Co.). Athens (Athens Co.). Washington Co. Hamilton Co. Ft. Hill, 1 mi. N. of Russellville (Highland Co.). Jackson Twp. (Pike Co.). Washington Twp., Rock Run (Jackson Co.). Scipio (Meigs Co.). Tiffin Twp., Meigs Twp., Oliver Twp. (Adams Co.). Shawnee Forest (Scioto Co.). Lake Laramie. Gallia (Gallia Co.). Dean Forest (Lawence Co.).

INDIANA: Adams Co. Lafayette (Tippecanoe Co.). Muncie (Delaware Co.). *Putnam Co. *Marion Co. *Vigo Co.[39] Spencer, McCormick's Creek St. Park (Owen Co.). *Bloomington (Munroe Co.). Knox Co. Hanover (Jefferson Co.). Dubois Co. ½ mi. W. of Speeds (Clark Co.). *Crawford Co.[39] *Lake Co. *Orange Co.[39] *Kosciusko Co.[39] Posey Co.[39]

ILLINOIS: Galena (Jo Daviess Co.). *Savanna (Carroll Co.). *Algonquin, McHenry, *Richmond (McHenry Co.). Glen Ellyn (Dupage Co.). Willow Springs, *Chicago, *Kenilworth, *Rivergrove, *Riverside, *Winnetka (Cook Co.). Moline (Rock Island Co.). Amboy (Lee Co.). *Galesburg (Knox Co.). Danvers and *Bloomington (McLean Co.). *Bryant (Fulton Co.). *Havana, *Quiver Lake (Mason Co.). *White Heath (Piatt Co.). *Urbana, *Mahomet, *Homer (Champaign Co.). *Oakwood, *Muncie (Vermilion Co.). *Paris (Edgar Co.). *Pike (Pike Co.). *Hardin (Calhoun Co.). Tower Hill (Shelby Co.). *Woodyard (Edgar Co.). *Marshall (Clarke Co.). *Dubois (Washington Co.). *Mt. Carmel (Wabash Co.). Carmi (White Co.). *Lawrenceville (Lawrence Co.). *Carbondale, *Grand Tower (Jackson Co.). *Alto Pass, *Aldridge,

[39] Recorded by Blatchley (Ann. Rep. Dept. Geol. and Nat. Res. Indiana, 1902, p. 224 (1903)) as *Tettix arenosus*.

*Dongola, *Cobden, *Anna, *Jonesboro (Union Co.). *Vienna (Johnson Co.). *Karnak, *Pulaski, *Villa Ridge (Pulaski Co.). *Herod (Pope Co.). *Metropolis (Massac Co.).

KENTUCKY: Burnside (Pulaski Co.). Guthrie (Todd Co.). Fulton (Fulton Co.). 5 mi. SW. of Corbin (Whitley Co.). 3 mi. S. of Wasioto (Bell Co.). Wycliffe.

TENNESSEE: *Roan Mountain, 5300 ft. and 6100 ft. (Carter Co.).[40] Roaring Forks, Great Smoky Nat. Park. Chilhowee Mountains (Blount Co.) *Knoxville (Knox Co.). La Follette (Campbell Co.). Brushy Mountain, near Petros (Morgan Co.). Between Madisonville and Gudger, 900 ft. (Monroe Co.). Clear Fork, near Burrville (Morgan Co.). *Chattanooga (Hamilton Co.).[38] East Ridge (Hamilton Co.). Grassy Cove, 1600, 1700, 1800 and 2500 ft. (Cumberland Co.). Allardt, 1300, 1400-1600 ft. (Fentress Co.). Antioch (Trousdale Co.). Lebanon (Wilson Co.). Lebanon Park (Wilson Co.). Cedar of Lebanon Park (Wilson Co.). Nashville (Davidson Co.). 13 ms. SE. of Nashville (Davidson Co.). Radnor Lake (Davidson Co.). 1.5 ms. W. of Donelson (Davidson Co.). 4.3 ms. NE. of Madison (Davidson Co.). Couchville (Davidson Co.). 1 m. SE. of Franklin (Williamson Co.). 3.4 ms. SE. of Franklin (Williamson Co.). 5.4 ms. SE. of Franklin (Davidson Co.). 2.4 ms. NE. of Nolensville (Williamson Co.). 2.8 ms. NW. of Bethlehem (Williamson Co.). 1.3 ms. W. of Triune (Williamson Co.). 7.7 ms. NW. of College Grove (Williamson Co.). ¼ m. S. of Davidson-Williamson county line (Williamson Co.). 3 ms. NE. of Lavergne (Rutherford Co.). ½ m. E. of Rocky Ford (Rutherford Co.). 5.2 ms. E. of Shelbyville (Bedford Co.). *Winchester (Franklin Co.). 1.4 ms. E. of Mulberry (Lincoln Co.). 2 ms. W. of Coldwater (Lincoln Co.). 9 ms. W. of Pulaski (Giles Co.). *Clarksville (Montgomery Co.). Reelfoot Lake (Obion Co.). Memphis (Shelby Co.).

ALABAMA: Elgin (Lauderdale Co.). *Valley Head (DeKalb Co.).[38] *Tuscaloosa (Tuscaloosa Co.).[38] Opelika (Lee Co.). Selma (Dallas Co.). Kushla (Mobile Co.). Mobile (Mobile Co.).

MISSISSIPPI: Oxford (Lafayette Co.). Greenville (Washington Co.). Winona (Montgomery Co.). 8 ms. E. of Vicksburg (Warren Co.). Jackson (Hinds Co.). *Utica (Hinds Co.).[41] Strickton (Rankin Co.). *Meridian (Lauderdale Co.).[38] Hattiesburg (Forrest Co.)[38]

ARKANSAS: *Fayetteville (Washington Co.).[38] *Winslow (Washington Co.).[38] 10 ms. S. of Jasper, 2500 ft. (Newton Co.). 4 ms. SW. of Mountain View (Stone Co.). 4.5 ms. SW. of Inboden (Lawrence Co.). Osceola (Mississippi Co.). 6 ms. E. of Fair Oaks (Cross Co.). Scott Co. *Ola (Fell Co.).[38] Polk Co. *De Queen (Sevier Co.).[38] *Ashdown (Little River Co.).[38]

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[40] In the small series from the Museum of Zoology of the University of Michigan are two males labelled as from 6000 feet on Roan Mountain, taken August 6, 1922, which are clearly atypical *T. a. arenosa*, which we are convinced have been inadvertently labelled for locality. Atypical *T. a. arenosa* is not known from any elevation approximating this and from no locality from within some hundreds of miles of Roan Mountain.

LOUISIANA: Arcadia (Bienville Parish). West Monroe (Ouachita Parish) Bee Bayou, 2 ms. E. of Rayville (Richland Parish). Delta (Madison Parish). Alexandria (Rapides Parish). Pineville (Rapides Parish). Opelousas (St. Landry Parish).[42] Eunice (St. Landry Parish). Baton Rouge (East Baton Rouge Parish). Le Bleu Settlement (Calcasieu Parish). Morgan City (St. Mary Parish).

WISCONSIN: Polk Co. Lake Puckaway. *Montello (Marquette Co.). Platteville (Grant Co.).

MANITOBA: Aweme.

MINNESOTA: *Warroad (Roseau Co.). *Big Falls and *Little Fork (Koochiching Co.). Plummer (Red Lake Co.). Crookstone (Polk Co.). *Norman Co. *Fergus Falls (Ottertail Co.). *Princeton (Mille Lacs Co.). *Mora (Kanabec Co.). Coon Creek, *Rice Creek (Anoka Co.). *Madison (Lac Qui Parle Co.). *Fort Snelling (Hennepin Co.). St. Paul and *St. Anthony Park (St. Paul Co.). *Nr. Lawrence (Carver Co.). *Redwood Falls (Redwood Co.). *Savage (Scott Co.). *Ottawa (Le Sueur Co.). Frontenac (Goodhue Co.). *Pipestone (Pipestone Co.). *Gray Cloud Island (Ramsey Co.). *Olmsted Co. Burnside. *Cliff. *Battle Creek.

IOWA: *Sioux Co. *Clay Co. *Hancock Co. *Pocahontas Co. *Clayton Co. *Bueno Vista Co. *Bremer Co. *Sioux City (Woodbury Co.). *Webster Co. *Harden Co. *Buchanan Co. *Delaware Co. *Dubuque Co. *Crawford Co. *Boone Co. *Greene Co. *Ames (Story Co.). *Linn Co. *Jones Co. *Jackson Co. *Guthrie Co. *Dallas Co. *Polk Co. *Homestead (Iowa Co.). *Iowa City (Johnson Co.). *Cedar Co. *Scott Co. *Muscatine Co. *Mahaska Co. *Washington Co. *Louisa Co. *Mills Co. *Wapello Co. *Jefferson Co. *Mt. Pleasant (Henry Co.). *Des Moines Co. *Fremont Co. *Wayne Co. *Appanoose Co. *Van Buren Co. *Lee Co.

MISSOURI: Kansas City, Atherton (Jackson Co.). Columbia (Boone Co.). St. Louis (St. Louis Co.). Willard (Greene Co.). Van Buren (Carter Co.).

NORTH DAKOTA: *Fargo (Cass Co.).

SOUTH DAKOTA: Sisseton (Roberts Co.). Dupree (Ziebach Co.). *Capa (Jones Co.). Oacoma (Lyman Co.). Sioux Falls (Minnehaha Co.) Rosebud (Todd Co.). Bonesteel (Gregory Co.). Centerville (Turner Co.). *Canton (Lincoln Co.). *Springfield (Bonhomme Co.). Yankton (Yankton Co.). Vermillion (Clay Co.). Redfield (Spink Co.). Union St. Park, Jefferson, *Elk Point (Union Co.).

NEBRASKA:[43] Maskell (Dixon Co.). West Point (Cuming Co.). Milford (Seward Co.). Fremont (Dodge Co.). *Cedar Bluffs (Saunders Co.). Omaha (Douglas Co.). Gretna (Sarpy Co.). *Lincoln, *Roca, Raymond

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[41] Recorded as *arenosus* by Ashmead (Insect Life VII, p. 26 (1894)).

[42] A number in this series in the collection of the Academy of Natural Sciences of Philadelphia, ex Hancock, were labelled by that author as *arenosa*.

(Lancaster Co.). South Bend, Plattsmouth, Nebawka, Weeping Water, *Nebraska City (Otoe Co.). Louisville (Cass Co.). Dorchester (Saline Co.). Peru (Nemaha Co.).

KANSAS: *Rawlins Co. *Norton Co. *Manhattan (Riley Co.). Pottawatomie Co. *Doniphan Co. *Topeka (Shawnee Co.). Lawrence (Douglas Co.). *Dickinson Co. *Coffey Co. *Medora (Reno Co.). *Wichita (Sedgwick Co.). *Sumner Co. *Cowley Co. *Montgomery Co. *Cherokee Co.

OKLAHOMA: *Ottawa Co. Craig Co. Bluejacket (Craig Co.). Grove (Delaware Co.). Latimer Co. *Howe (Le Flore Co.).[38] McCurtain Co. Idabel (McCurtain Co.). 6.5 ms. NE. of Idabel (McCurtain Co.). *Eagletown (McCurtain Co.). Cherokee Co. *McAlester (Pittsburg Co.).[38] Payne Co. Stillwater (Payne Co.). Logan Co. Davis (Murray Co.).

TEXAS: Bowie Co. *Denison (Grayson Co.).[38] Wolfe City (Hunt Co.). Greenville (Hunt Co.). Dallas Co. Dallas (Dallas Co.). Athens (Henderson Co.). Longview (Gregg Co.). Waco (McLennan Co.). 1.9 ms. E. of Trinity River on U. S. 190 (Polk Co.). Hearne (Robertson Co.). Tiger Mills (Burnet Co.). Paige (Bastrop Co.). Beaumont (Jefferson Co.). Palmetto State Park, Luling (Caldwell Co.). Sequin (Guadalupe Co.). 6 ms. N. of New Braunfels (Guadalupe Co.). 1 m. E. of Selma (Bexar Co.). 3 ms. S. of Kendalia (Kendall Co.).

Atypical *Tetrix arenosa angusta*

TEXAS: 9 ms. E. of Trinity River on U. S. 190 (Polk Co.). Houston (Harris Co.).

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[43] Most of the Nebraska records given by Hauke (Bull. Univ. Neb. State Mus., 3, no. 9, p. 4 (1953)) for *Tetrix ornata* really relate to *T. arenosa angusta*.